

# 24-hour central blood pressure is better associated with target organ damage of hypertension than brachial blood pressure



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# Background

- Ambulatory blood pressure (ABP), central BP and pulse wave velocity (PWV) are parameters indicated by current hypertension guidelines as useful for better estimating BP control and vascular impairment of the hypertensive patient
- Recent advances in technology made available devices allowing combined non-invasive estimation of BP and arterial stiffness in ambulatory conditions over the 24-hours
- At present, there is limited evidence on the usefulness of such an approach in the clinical practice and much has still to be done to prove its actual benefit for hypertension management

# Objective

- The VASOTENS Registry is an international, multicenter, observational, non-randomized, prospective (investigator-initiated) study aiming at evaluating the impact of 24-hour pulse wave analysis (PWA) of ambulatory blood pressure monitoring (ABPM) recordings on target organ damage and cardiovascular prognosis of hypertensive patients
- In the present analysis of study baseline data we checked whether organ damage of hypertension
  - i) is better associated with 24-hour central than peripheral BP
  - ii) is related to ambulatory arterial stiffness, estimated by PWV and augmentation index (AIx)

# Vascular health **AS**essment **O**f **T**he hypert**ENS**ive patients

## **Project Coordinator:**

Stefano Omboni (Italy)

## **Co-coordinator:**

Igor Posokhov (Russia)

## **Steering Committee:**

Stefano Omboni (Italy), Gianfranco Parati (Italy), Igor Posokhov (Russia), Anatoli Rogoza (Russia)

## **Scientific Committee:**

Stefano Omboni (Italy), Gianfranco Parati (Italy), Igor Posokhov (Russia), Anatoli Rogoza (Russia), Yulia Kotovskaya (Russia)

## **Technical support:**

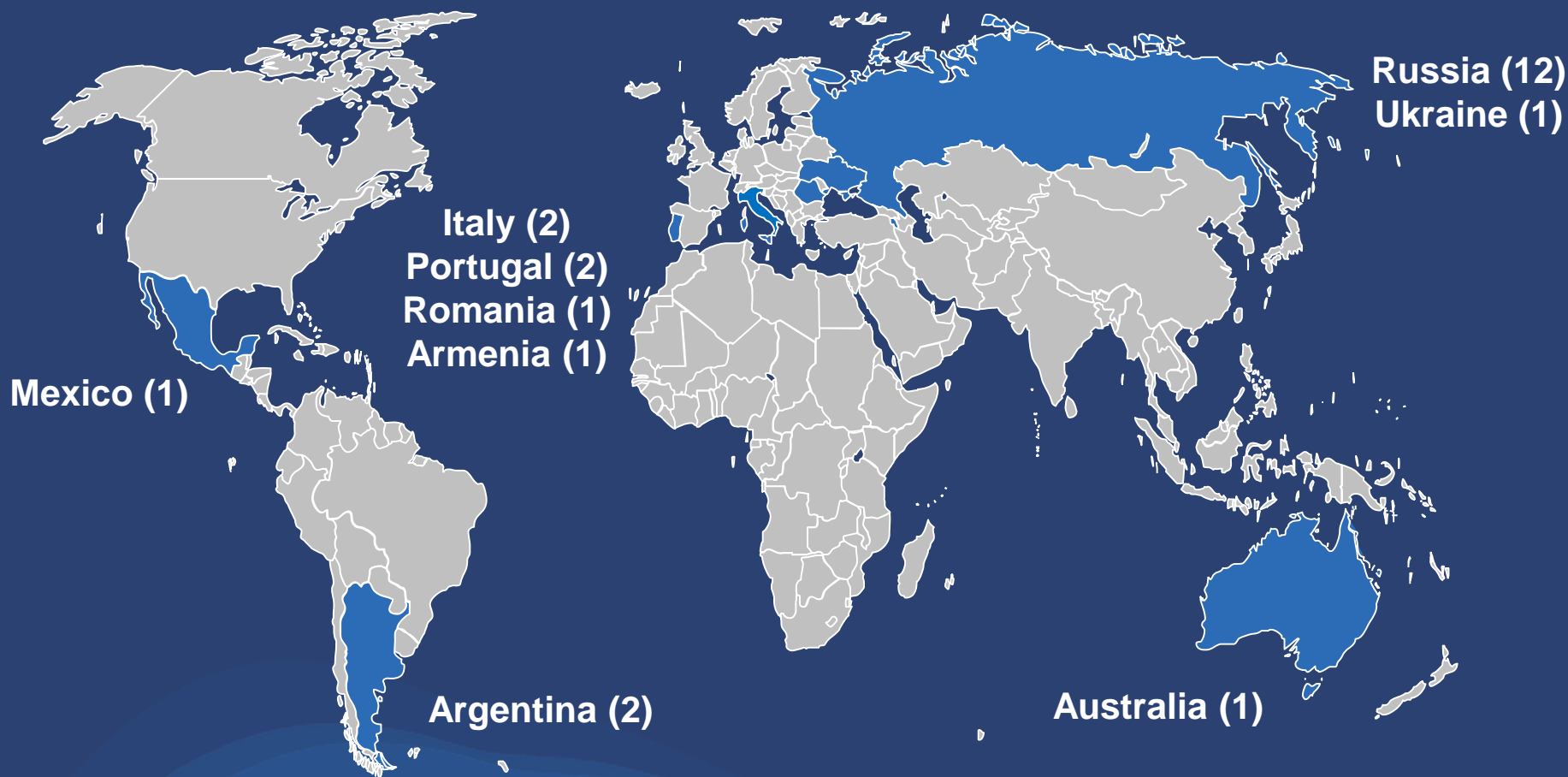
BPLab GmbH (Germany)

## **Endorsement:**



# Study sites

## (23 centers and 9 countries)



# Study centers

## Providing data for the first analysis

**Italy:** Giuseppe Mulè (Palermo), Maria Lorenza Muiesan, Damiano Rizzoni (Brescia)

**Mexico:** Ernesto Cardona Muñoz, Carlos Ramos, Adrian Alanis (Guadalajara)

**Portugal:** Telmo Pereira (Coimbra)

**Russia:** Iana Orlova, Natalya Kurlykina (Moscow), Elena Grigoricheva, Vitaly V Evdokimov, Anastasiya Yu Kuznetsova (Chelyabinsk), Vitaliy Barkan, Marina Gubanova, Viktoria Lazareva (Chita), Irina Minyukhina, Irina Borisova, Tatiana Svetozarsky (Nizhniy Novgorod)

## Other and new recruiting centers

**Argentina:** Pedro Forcada (Buenos Aires), Gabriel Waisman (Buenos Aires)

**Armenia:** Parounak Zelveian (Yerevan)

**Australia:** Alberto Avolio, Mark Butlin, Edward Barin (Sydney)

**Portugal:** João Manuel Peixoto Maldonado (Coimbra)

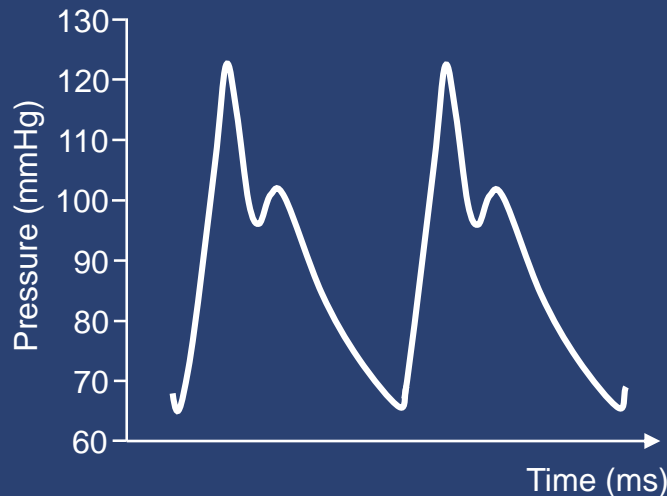
**Romania:** Ioan Tilea, Andreea Varga (Tirgu Mures)

**Russia:** Viktoria Korneva, Tatyana Kuznetsova (Petrozavodsk), Mikhail E. Statsenko, Maria V. Derevyanchenko (Volgograd), Philippe Kopylov (Moscow), Natalia Bulanova (Moscow)

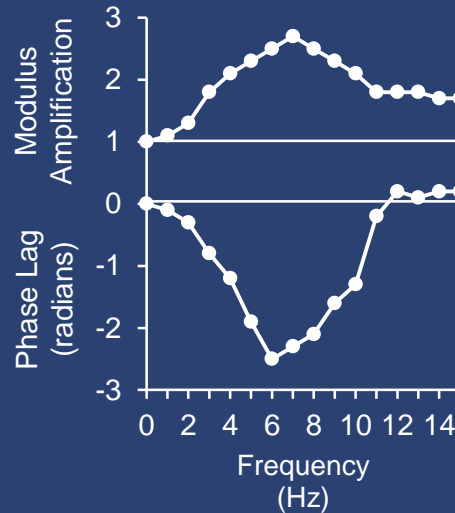
**Ukraine:** Yuriy M. Sirenko, Oksana Recovets (Kiev)

# The PWA technology

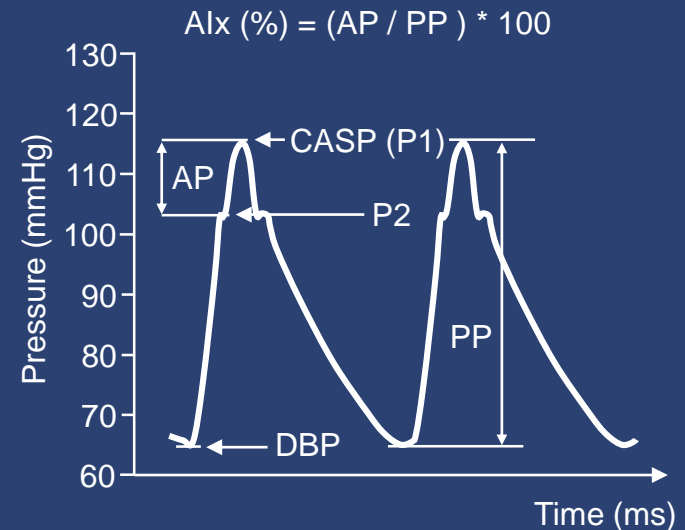
## A. Peripheral waveform



## B. Amplitude and phase characteristics of the generalized transfer function

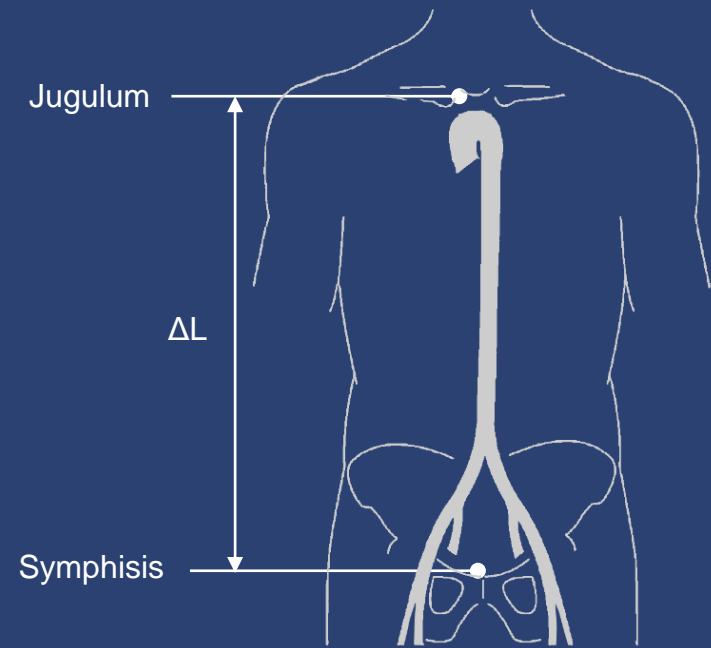
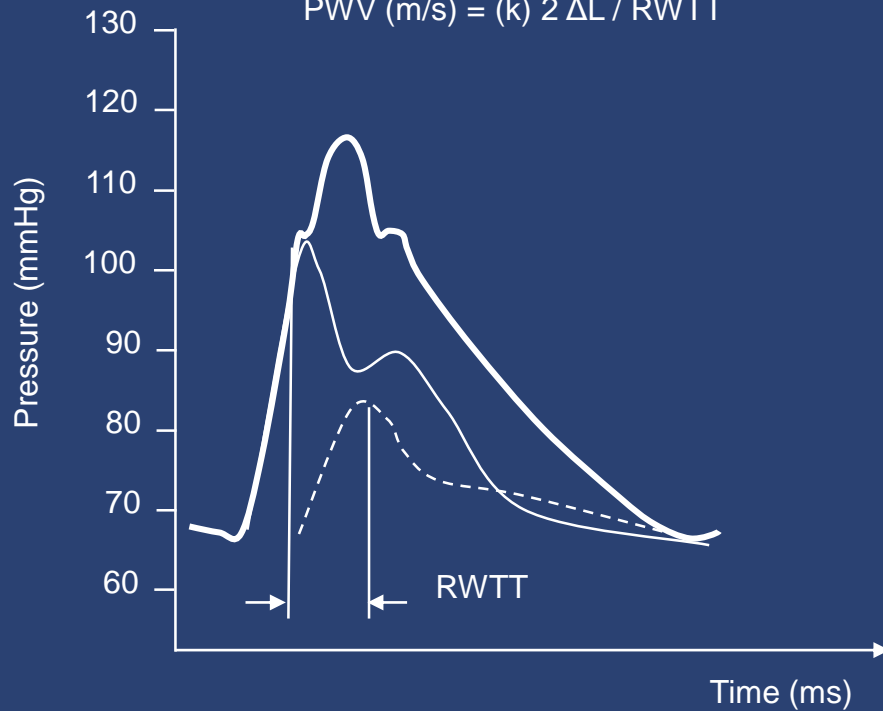


## C. Central waveform and main calculations



# The PWA technology

Example of wave separation method,  
 $PWV (m/s) = (k) 2 \Delta L / RWTT$



- Resulting pulse wave
- Forward pulse wave
- Backward pulse wave



# A clinically validated CE and ISO technology

## BP measurement

| Author (year)       | Subjects                        | BHS grade | SBP diff. Mean (SD) | DBP diff. Mean (SD) |
|---------------------|---------------------------------|-----------|---------------------|---------------------|
| Koudryavtcev (2011) | 85 adults (18-87 years)         | A / A     | 1.1 (6.4)           | -1.2 (7.1)          |
| Ledyaev (2015)      | 30 children (5-15 years)        | A / A     | 1.6 (2.2)           | 0.7 (3.1)           |
| Dorogova (2015)     | 30 pregnant women (20-35 years) | A / A     | 0.0 (2.1)           | 0.2 (2.2)           |

## PWA

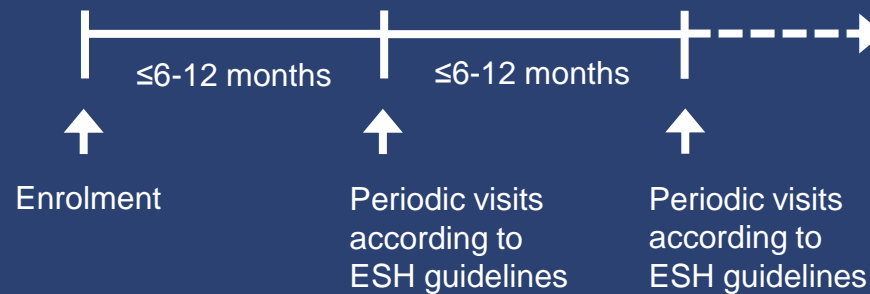
| Author (year)     | Subjects  | Results (BPLab vs. SphygmoCor)  |
|-------------------|---|---|
| Rogoza (2012)     | 160 patients and healthy volunteers (18-81 years) | Aortic SBP: 122.5 vs. 121.2 (-1.3 mmHg)<br>Aortic AI: 26.1 vs. 26.8 (-0.7%)                             |
| Kotovskaya (2014) | 99 subjects (18-77 years) (ARTERY protocol)       | Aortic SBP: 123 vs. 120 (2.9 mmHg)<br>Aortic AI: 13 vs. 11 (2.6 %)<br>Aortic PWV: 7.7 vs. 7.0 (0.7 m/s) |
| Butlin (2015)     | 45 subjects (46±17 years)                         | Aortic SBP: r=0.76<br>Aortic AIx: r=0.32  |

10 publications (clinical studies) including **699 normotensive healthy subjects** and **1147 hypertensives**

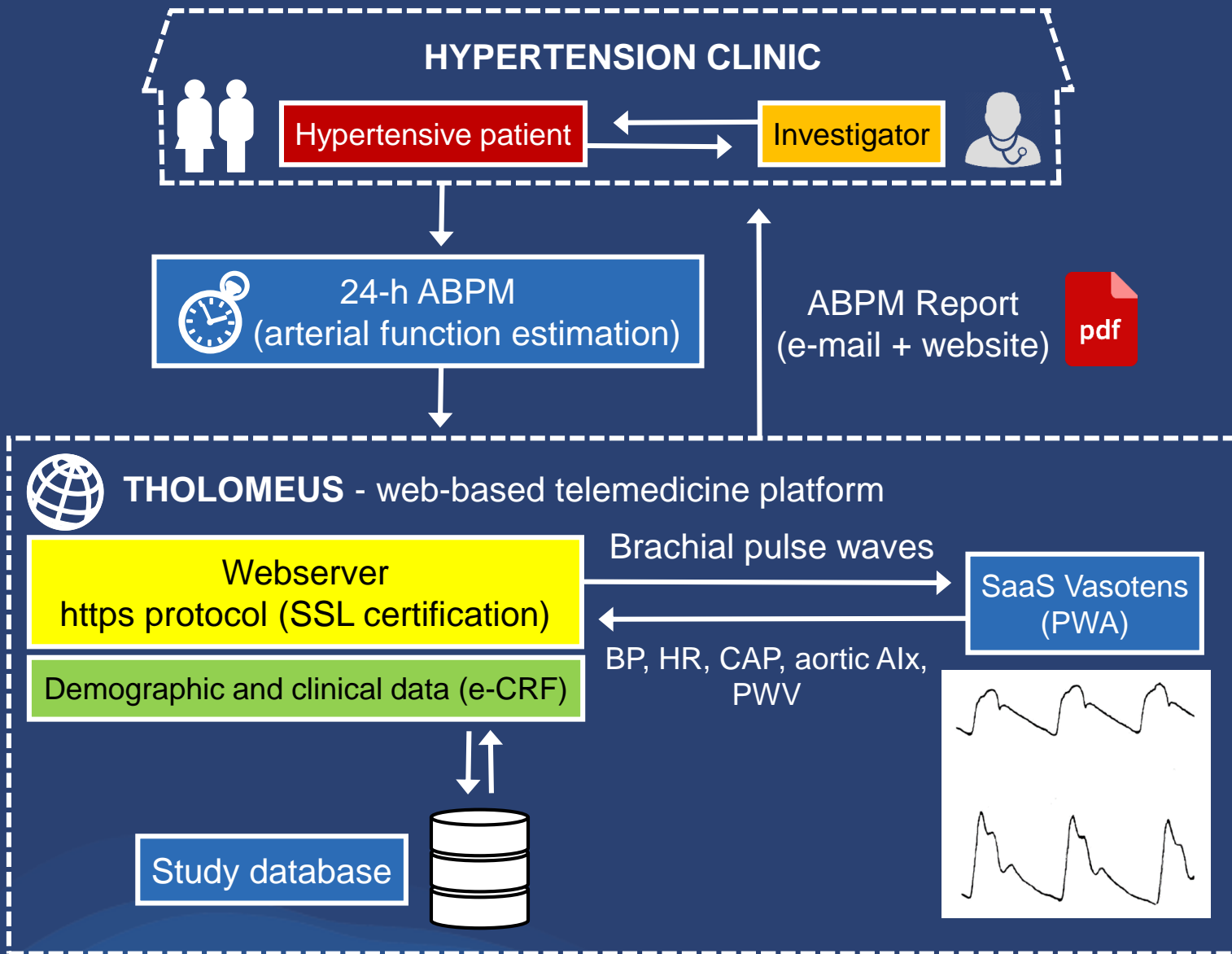
# Inclusion criteria

- Male and female subjects
- Age  $\geq 18$  years
- Subjects referred to routine diagnostic evaluation for hypertension or established hypertensive subjects
- ABPM performed for clinical reasons with a BPLab device
- Valid ABPM (interval between measurements  $\leq 30$  minutes, at least 70% of expected number of readings, at least 20 valid readings during the day-time and 7 during the night-time)

# Study flow-chart



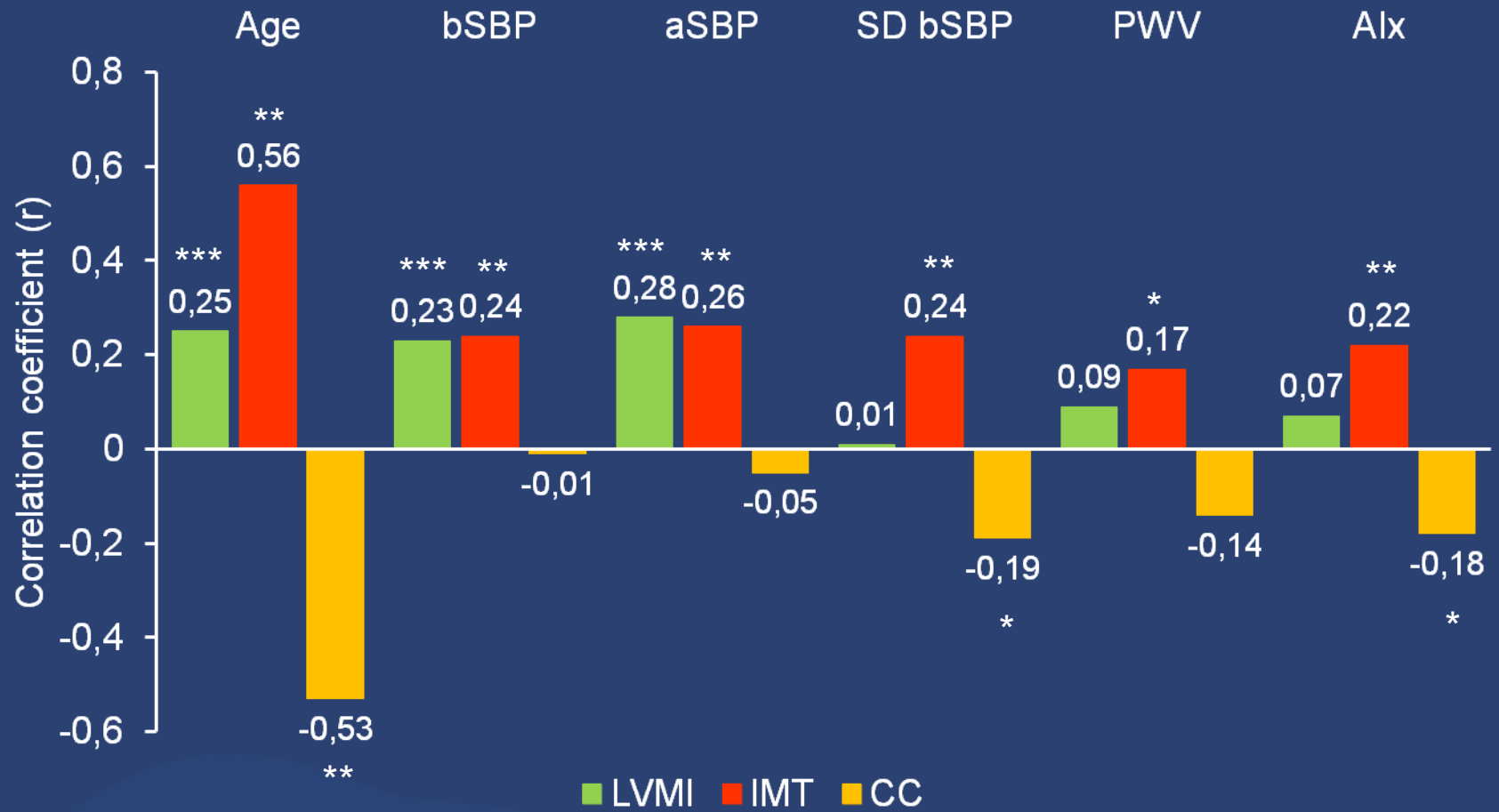
- Family history
- Anthropometric data
- Habits
- Past and current diseases
- Therapies
- Office and ABP
- Outcomes (AEs)
- Target organ damage (TOD)
  - Left ventricular mass index (LVMI) at echocardiogram
  - Intima-media thickness (IMT) at carotid ultrasonography
  - Calculation of estimated creatinine clearance (CC, Cockcroft-Gault Equation)



# Population characteristics (n=334)

|                          |                          |
|--------------------------|--------------------------|
| Age (years)              | 52.9 ± 15.1              |
| Male / female            | 173 (51.%) / 161 (48.2%) |
| Antihypertensive therapy | 151 (45.2%)              |
| Valid hours              | 22.4 ± 1.7               |
| 24-hour bSBP (mmHg)      | 127.6 ± 14.6             |
| 24-hour bDBP (mmHg)      | 79.4 ± 9.7               |
| 24-hour aSBP (mmHg)      | 115.0 ± 14.1             |
| 24-hour aDBP (mmHg)      | 79.8 ± 10.3              |
| 24-hour SD bSBP (mmHg)   | 13.4 ± 3.4               |
| 24-hour SD bDBP (mmHg)   | 10.4 ± 2.7               |
| Alx (%)                  | 28.6 ± 11.1              |
| PWV (m/s)                | 7.7 ± 2.6                |
| LVMI (g/m <sup>2</sup> ) | 100.4 ± 30.6             |
| IMT (mm)                 | 1.3 ± 0.9                |
| CC (ml/min)              | 85.1 ± 31.6              |

# Bivariate correlations



# Multivariate analysis

| <b>LVMI</b> | <b>Standardized regression coefficient (95% CI)</b> | <b>p-value</b> |
|-------------|---|----------------|
| Age         | 0.181 (0.159, 0.616)                                | 0.001          |
| aSBP        | 0.246 (0.305, 0.774)                                | 0.0001         |
| <b>IMT</b>  | <b>Standardized regression coefficient (95% CI)</b> | <b>p-value</b> |
| Age         | 0.561 (0.023, 0.035)                                | 0.0001         |
| <b>CC</b>   | <b>Standardized regression coefficient (95% CI)</b> | <b>p-value</b> |
| Age         | -0.525 (-1.443, 0.815)                              | 0.0001         |

# Conclusions

- In hypertensive patients age appears to be the major determinant of organ damage, with central SBP, and marginally peripheral SBP, PWV and Aix, also playing a significant role
- Our results suggest that estimation of 24-hour central hemodynamics and arterial stiffness in ambulatory conditions may help improve the individualized assessment of the BP-associated organ damage of hypertension



# The study website

## www.vasotens.org



# VASOTENS Registry

PROJECT

ORGANIZATION

INVESTIGATORS

### VASOTENS Registry

The “**INTERNATIONAL REGISTRY FOR AMBULATORY BLOOD PRESSURE AND ARTERIAL STIFFNESS TELEMONITORING**”, also called **VASOTENS (Vascular health ASsessment Of The hypertENSive patients) Registry**, has been devised in order to collect evidence on the clinical value of ambulatory arterial stiffness estimation. The final goal of the project is to achieve a possibly standardized and widespread use of integrated ambulatory blood pressure and arterial stiffness evaluation in the clinical management of hypertension, also by providing specific instructions and recommendations to the clinicians on the use of this modern technology. The project is an investigator initiated observational, prospective trial.

Basically, the **Vasotens Registry is an open project**, collecting common archive of ambulatory blood pressure recordings from all collaborators for subsequent analysis, intending to reach a strong evidence base and to improve risk stratification in arterial hypertension management. The members of the Registry are authors of studies or scientific publications on 24-hour ambulatory monitoring of brachial and central aortic blood pressure and 24-hour pulse wave analysis. Given the open nature of the project, any investigator ready to contribute with ambulatory blood pressure data, which strictly correspond to the established criteria can join the Registry.



# **VASOTENS** Registry

If you want to join the study send inquiry to:

[coordinator@vasotens.org](mailto:coordinator@vasotens.org)

**THANK YOU FOR ATTENTION!**